

## EFFECT OF JUVENOIDS ON TERMITES AND HONEYBEES.

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In the near future, some of the juvenile hormone analogues (JHA or juvenoids) are likely to be used in insect control. In this respect the possible effects of JHA on social insects is important and interesting. The specificity of the synthetic juvenoids (in contrast to the natural juvenile hormone) can be postulated according to the published structure-activity relationships. Many of the known JHA are active in Hemipteran, Coleopteran, Homopteran, Dipteran and/or Homopteran insects. Relatively poor information on the activity of JHA in Hymenoptera is available. (Sehnal, 1971; Sláma, 1971; Staal, 1972).

### TERMITES

The role of the juvenile hormone (JH) in caste determination in termites was shown by Lüscher (1958), Lüscher & Springhetti (1960) and confirmed by Lebrun (1967). In these experiments the development of the soldier castes, mainly of pre-soldiers (white soldiers), or soldier-worker intercastes, was induced by implantation of active corpora allata. Also Lüscher (1969) was the first to obtain pre-soldiers by the treatment of the termite larvae or pseudergates with synthetic JH. In all these experiments the European dry-wood termite Kaloterмес flavicollis (Fabr.) was used.

### LABORATORY EXPERIMENTS WITH TERMITES

In our experiments (Hrdý & Křeček, 1972; Hrdý, 1972) we used a new subject - the European subterranean termite Reticulitermes lucifugus santonensis Feyt. By the method of permanent exposure of termite groups placed in Petri-dishes (30 pseudergates and grown larvae), to filter paper (Whatmann 1- ø 40 mm), treated with 0.2 ml of acetone solution of the test compound, we tested the activity of approximately 50 JHA. As a standard, the synthetic Cecropia JH: (1) 17% all trans + 83% trans, cis-methyl 10-epoxy-3,7,11-trimethyl-2,6 tridecadienoate (Meyer et al., 1968) was applied.

In experiments with R. lucifugus santonensis the following JHA were the most active: (2) Methyl (2E) 11-chloro-3,7,11-trimethyl-2-dodecenoate (Jarolím et al., 1969); (3) ethyl (2E, 4E)-3,7,11-trimethyl-2,4-dodecadienoate (Henrick, 1972) and (4) isopropyl 3,7-dimethyl-9-(2-tetrahydrofuryl)-2,4-nona-dienoate (Hejno, Sláma & Šorm, 1973). The ratio of one soldier to 100-300 other individuals was common in the culture colonies. In our present controls no soldier induction was observed. However, in termite groups treated with compounds (1), (2), (3), (4) the caste ratio was markedly shifted in favour of the soldier caste. With the higher concentration of JHA (0.5%) increased mortality was recorded. The caste ratio in survivals was, after twelve-days of exposure, 29 (pseudoworkers): 130 (pre-soldiers and/or intercastes) if treated with compound (1), 64:47 with compound (2), 76:38 with compound (3). For the compound (2) the concentration of 0.5% was necessary to induce a high soldier

production and mortality. For compound (3), a concentration of 0.05% was sufficient for a striking induction of soldiers and in the case of compound (4), 100% soldier induction was achieved by exposure of termites to a 0.05% concentration.

We further tested for the critical exposure time. After a three-day exposure to (3) a sporadic effect was observed. However, after a nine-day exposure a striking development of many superfluous pre-soldiers and/or intercastes (with high mortality, mostly during the moult) was observed. We also induced an increase in superfluous soldiers in Prorhinotermes simplex (Hagen) by concentrations of 0.5% of (2) and 0.5%, 0.05% of (3).

#### HONEYBEES

The first information on the influence of exogenous JH on the differentiation of the honeybee queens was recently published by Wirtz & Beetsma, (1972); Wirtz (1973). Very interesting in this connection is Rembold's report on "Determinationsstoff" in the royal jelly, which may be substituted by a "silk worm extract" to achieve a similar effect, namely the differentiation of brood to queen-like individuals. Žďárek & Haragzim screened about 40 juvenoids on honeybee pupae and found that the range of dosages inducing morphogenetic effects was very large.

#### EFFECT OF JUVENOIDS ADMINISTERED TO HONEYBEES IN FOOD

Two JH compounds were tested. The first JHA is considered to be promising in aphid control (3)\* and the second one is relatively effective on various insect pests including some Lepidoptera (2). These compounds were administered in sugar solution to small, one-frame colonies of Apis mellifera carnica, Troiseck strain. The total amount of JHA consumed by the individual honeybee colonies during 32 days of the experiment was extremely high: 9.8 g and 15.5 g of the compound (2) and 7.5 g or 10.9 g respectively of the compound (3). The consumption of sugar solution was slightly inhibited (in comparison with the controls) by addition of JHA. In spite of the very high dosages of both JHAs, no toxic effect on adult worker bees was observed. However, in the colonies treated with JHA, the black brood was carried away and no healthy brood in the larval stage was observed, while the sealed brood and (in one case) the eggs were still present. In two of four JHA-treated colonies the queens were killed and at the end of the experiment only adult worker bees and queens were left in JHA treated colonies.

#### GREEN HOUSE EXPERIMENTS WITH HONEYBEES

The compounds (2) and (3) both in the ratio of 2:1 of 0.5% emulsion were sprayed on to radish plants (grown in green houses for seed production) in cages (3.25 m x 11 m). Two honeybee colonies

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\* Zoecon Insect Growth Regulator Altozar™

were placed in individual plots. The sprays were applied in the afternoon (when the honeybees stopped foraging). However, as the result of the application of JHA (2), worker bees resumed their foraging. During the experiment, the radish plants were in blossom and frequently visited by the honeybees. According to the scoring of brood occurrence, and the quantity of the worker bees and their reserves, it became quite clear that the JHA had no harmful effect on the worker bees, but the development of brood was affected. Ten days after the experiment began there was no brood at the open larval stage (with exception of one of four colonies in JHA treated plots). The feeding as well as the green house experiments suggest that the worker bees are able to identify the brood harmfully influenced by JHA in its early developmental stages, and to remove such a brood.

The termite research continues by screening new juvenoids with higher specificity; in the investigation of juvenoid effectiveness on honeybees, the problem is how long will it take honeybee colonies to return to the normal development.

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